

## CLAIMS:

1. A hospital bed obstacle detection device for use with a hospital bed including a base frame and an elevating frame coupled to a patient support surface, said obstacle detection device controlling movement of the elevating frame relative to the base frame upon detecting an object within a path of travel of the elevating frame, said obstacle detection device comprising:

5 an emitter coupled to one of the base frame and the elevating frame of the bed, the emitter being configured to generate a wireless curtain extending below the elevating frame;

10 a receiver coupled to one of the base frame and the elevating frame of the bed, said receiver being configured to detect said wireless curtain; and

a control unit in communication with said receiver and configured to control movement of the elevating frame based on an output signal from said receiver.

15 2. The obstacle detection device of claim 1, wherein said emitter comprises an infrared light source, and said wireless curtain comprises an optical curtain.

20 3. The obstacle detection device of claim 2, further comprising a lens positioned proximate said infrared light source and configured to convert light emitted from said infrared light source to said optical curtain.

4. The obstacle detection device of claim 3, wherein said lens comprises a fresnel lens.

25 5. The obstacle detection device of claim 1, wherein said wireless curtain includes a modulated signal and said receiver compares said modulated signal to a predefined verification signal to prevent interference from external light sources.

6. The obstacle detection device of claim 1, wherein said receiver is configured to move with said elevating frame within a predefined vertical range.

30 7. The obstacle detection device of claim 6, wherein said predefined vertical range is from said base frame to said elevating frame when said elevating frame is in a fully raised position.

8. The obstacle detection device of claim 1, further comprising an indicator in communication with the control unit, said indicator configured to indicate failure of said receiver to detect said wireless curtain.

9. The obstacle detection device of claim 8, wherein said indicator comprises a light.

10. The obstacle detection device of claim 8, wherein said indicator comprises an audible alarm.

5 11. The obstacle detection device of claim 1, wherein said control unit comprises a processor in communication with an actuator configured to move the elevating frame relative to the base frame.

10 12. The obstacle detection device of claim 1, wherein said control unit comprises a control relay coupled to an actuator configured to move the elevating frame relative to the base frame.

13. The obstacle detection device of claim 1, wherein:  
the emitter generates a plurality of wireless signals in a plurality of signal paths;

15 a plurality of receivers are configured to detect said wireless signals along different ones of said signal paths; and

said control unit prevents movement of the elevating frame relative to the base frame when any of said receivers fail to detect a wireless signal.

14. The obstacle detection device of claim 1, wherein said receiver generates said output signal when said receiver does not detect said wireless curtain.

20 15. A patient support apparatus comprising:  
a base frame;  
an elevating frame configured to move along a path of travel above said base frame;

25 a patient support surface supported by said elevating frame;  
a detector supported by one of said elevating frame and said base frame, said receiver configured to detect an obstacle within said path of travel of said elevating frame and provide a control signal in response thereto; and  
a control unit in communication with said detector and configured to prevent lowering of the elevating frame in response to said control signal.

30 16. The patient support apparatus of claim 15, further comprising an emitter supported by one of said base frame and said elevating frame, said emitter configured to generate a wireless signal.

17. The patient support apparatus of claim 16, wherein said emitter is supported by said base frame and said detector is supported for movement with said elevating frame.

5 18. The patient support apparatus of claim 15, wherein said detector comprises a camera configured to capture images of said elevating frame along said path of travel.

19. The patient support apparatus of claim 18, wherein said control unit is configured to compare the images captured by said camera to predefined images to determine the presence of an obstacle within said path of travel.

10 20. The patient support apparatus of claim 15, wherein said detector comprises a force sensing tape switch including elongated upper and lower contacts, said force sensing tape switch being coupled to the base frame.

21. The patient support apparatus of claim 15, wherein said emitter comprises an infrared light source.

15 22. A patient support apparatus comprising:  
a base frame;  
an elevating frame disposed in spaced relation to said base frame;  
a patient support surface supported by said elevating frame;  
an emitter coupled to one of said base frame and said elevating frame,  
20 said emitter being configured to generate a wireless signal; and  
a receiver coupled to one of said base frame and said elevating frame,  
said receiver associated with said emitter and configured to detect said wireless  
signal.

25 23. The patient support apparatus of claim 22, further comprising a lifting device configured to move said elevating frame vertically relative to said base frame;

24. The patient support apparatus of claim 23, further comprising a control unit in communication with said lifting device and said receiver, said control unit configured to prevent operation of said lifting device if said receiver fails to detect said wireless signal.

30 25. The patient support apparatus of claim 22, wherein said emitter generates an optical curtain positioned intermediate said base frame and said elevating frame.

26. The patient support apparatus of claim 21, wherein said emitter comprises an infrared light source.

27. The patient support apparatus of claim 26, further comprising a lens positioned proximate said infrared light source and configured to convert light emitted from said infrared light source to an optical curtain.

5 28. The patient support apparatus of claim 27, wherein said lens comprises a fresnel lens.

10 29. The patient support apparatus of claim 22, wherein said wireless signal includes a modulated signal and said control unit compares said modulated signal to a predefined verification signal to prevent interference from external light sources.

30. The patient support apparatus of claim 22, wherein said receiver is configured to move with said elevating frame within a predefined vertical range.

15 31. The patient support apparatus of claim 30, wherein said predefined vertical range is from said base frame to said elevating frame when said elevating frame is in a fully raised position.

32. The patient support apparatus of claim 22, further comprising an indicator in communication with the control unit, said indicator configured to indicate failure of said receiver to detect said wireless signal.

20 33. The patient support apparatus of claim 22, wherein said wireless signal includes a pulsed portion having a predefined frequency, and said receiver is configured to detect said predefined frequency.

34. The patient support apparatus of claim 33, wherein said predefined frequency is approximately 57 MHz.

25 35. The patient support apparatus of claim 34, wherein said pulsed portion has a duration of approximately 600 microseconds followed by a delay of approximately 2 milliseconds.

36. The patient support apparatus of claim 22, wherein:  
the emitter is configured to generate a plurality of wireless signals in a plurality of signal paths; and

30 a plurality of receivers are configured to detect said wireless signals along different ones of said signal paths, said control unit preventing movement of said elevating frame when any of said plurality of receivers fail to detect a wireless signal.

37. The patient support apparatus of claim 36, wherein at least one of said receivers is supported for movement with said elevating frame.

38. The patient support apparatus of claim 37, wherein said emitter is supported by said base frame.

5 39. A hospital bed obstacle detection device for use with a hospital bed including a base frame and an elevating frame coupled to a patient support surface, said obstacle detection device configured to prevent lowering of the elevating frame relative to the base frame upon detecting an object within a path of travel of the elevating frame, said obstacle detection device comprising:

10 at least one emitter configured to generate a first optical curtain extending proximate a first longitudinal side edge of the bed, and a second optical curtain extending proximate a second longitudinal side edge of the bed;

at least one first side receiver associated with said at least one emitter and configured to detect said first optical curtain;

15 at least one second side receiver associated with said at least one emitter and configured to detect said second optical curtain; and

20 a control unit in communication with said at least one first side receiver and said at least one second side receiver, said control unit configured to prevent movement of the elevating frame if either of said at least one first side receiver and said at least one second side receiver fails to detect said first optical curtain and said second optical curtain, respectively.

40. The obstacle detection device of claim 39, wherein said at least one emitter comprises an infrared light source.

25 41. The obstacle detection device of claim 40 further comprising a lens positioned proximate said infrared light source and configured to convert light emitted from said infrared light source to said optical curtain.

42. The obstacle detection device of claim 41, wherein said lens comprises a fresnel lens.

30 43. The obstacle detection device of claim 42, wherein each said optical curtain includes a modulated signal and each said receiver compares said modulated signal to a predefined verification signal to prevent interference from external light sources.

44. The obstacle detection device of claim 39, wherein each said receiver is configured to move with said elevating frame within a predefined vertical range.

45. The obstacle detection device of claim 44, wherein said predefined vertical range is from said base frame to said elevating frame when said elevating frame is in a fully raised position.

5 46. The obstacle detection device of claim 39, further comprising an indicator in communication with the control unit, said indicator configured to indicate failure of said receiver to detect said optical curtain.

10 47. The obstacle detection device of claim 46, wherein said indicator comprises a light.

48. The obstacle detection device of claim 47, wherein said indicator comprises an audible alarm.

15 49. The obstacle detection device of claim 39, wherein said control unit comprises a processor in communication with an actuator configured to move the elevating frame relative to the base frame.

50. The obstacle detection device of claim 39, wherein said control unit comprises a control relay coupled to an actuator configured to move the elevating frame relative to the base frame.

20 51. A hospital bed obstacle detection device for use with a hospital bed including a base frame and an elevating frame coupled to a patient support surface, said obstacle detection device controlling movement of the elevating frame relative to the base frame upon detecting an object within a path of travel of the elevating frame, said obstacle detection device comprising:

25 means for generating a wireless curtain within a path of travel of the elevating frame;

means for detecting said wireless curtain and generating a signal in response thereto; and

means for receiving said signal and controlling movement of the elevating frame in response thereto.

30 52. The hospital bed obstacle detection device of claim 51, wherein said means for generating a wireless curtain comprises an infrared light source.

53. The obstacle detection device of claim 52, further comprising a lens positioned proximate said infrared light source and configured to convert light emitted from said infrared light source to said wireless curtain.

5 54. The obstacle detection device of claim 53, wherein said lens comprises a fresnel lens.

10 55. The obstacle detection device of claim 51, wherein said wireless curtain includes a modulated signal and said detecting means compares said modulated signal to a predefined verification signal to prevent interference from external light sources.

15 56. The obstacle detection device of claim 51, wherein said detecting means is configured to move with said elevating frame within a predefined vertical range.

20 57. The obstacle detection device of claim 56, wherein said predefined vertical range is from the base frame to the elevating frame when the elevating frame is in a fully raised position.

25 58. The obstacle detection device of claim 51, further comprising means for indicating a failure of said detecting means to detect said wireless curtain.

30 59. The obstacle detection device of claim 51, wherein said control means comprises a processor in communication with an actuator which moves the elevating frame relative to the base frame.

60. The obstacle detection device of claim 51, wherein said control means comprises a control relay coupled to an actuator which moves the elevating frame relative to the base frame.

25 61. A method of preventing movement of a component of a patient support surface upon detection of an obstacle within a path of travel of the component, said method comprising the steps of:

30 providing a patient support apparatus including a movable component;  
generating a detectable wireless signal within a path of travel of said component;

providing a receiver for detecting said wireless signal;  
moving said patient support surface;  
generating a stop signal if said receiver fails to detect said wireless signal; and

5 preventing movement of said patient support surface in response to said stop signal.

62. The method of claim 61, wherein said step of generating a detectable wireless signal comprises the steps of providing a light source and emitting infrared light from said light source.

10 63. The method of claim 62, further comprising the step of placing a lens proximate said light source for converting light emitted from said light source to said wireless curtain.

15 64. The method of claim 62, wherein said wireless signal includes a modulated signal and said receiver compares said modulated signal to a predefined verification signal to prevent interference from external light sources.

65. The method of claim 61, wherein said receiver is configured to move with said elevating frame within a predefined vertical range.

15 66. The method of claim 61, further comprising the step of activating an indicator in response to said stop signal.

67. The method of claim 61, wherein said movable component includes an articulating deck movable relative to an elevating frame, and the moving step includes moving said articulating deck relative to said elevating frame.

20 68. A hospital bed comprising:

a first component;

a second component movable relative to said first component;

an optical curtain generator coupled to said first component;

an optical curtain detector coupled to said second component; and

25 a control unit in communication with said detector, said control unit being configured to prevent relative movement of said first and second components upon failure of said detector to detect said optical curtain.

69. The hospital bed of claim 68, wherein said first component is one of an elevating frame and an articulating deck supported by said elevating frame, and said second component is the other of said elevating frame and said articulating deck.

30 70. The hospital bed of claim 69, wherein said first component is one of a base frame and an elevating frame supported by said base frame, and said second component is the other of said base frame and said elevating frame.

71. The hospital bed of claim 69, wherein said first component is a first siderail and said second component is a second siderail.

5 72. The hospital bed of claim 69, wherein the first component is one of an elevating frame and a siderail supported by said elevating frame, and said second component is the other of said elevating frame and said siderail.

73. The hospital bed of claim 69, wherein the first component is one of a footboard and a siderail, and said second component is the other of said footboard and said siderail.

10 74. A hospital bed comprising:

a first component;

a second component configured to move relative to said first component along a path of travel;

15 a detector supported by one of said first component and said second component, said detector configured to detect an obstacle within said path of travel of said second component and provide a control signal in response thereto; and

a control unit in communication with said detector and configured to prevent relative movement of said first and second components in response to said control signal.

20 75. The hospital bed of claim 74, further comprising an emitter supported by one of said first component and said second component, said emitter configured to generate a wireless signal.

76. The hospital bed of claim 75, wherein said emitter is supported by said first component and said detector is supported for movement with said second component.

25 77. The hospital bed of claim 75, wherein said emitter comprises an infrared light source.

78. The hospital bed of claim 77, wherein said wireless signal includes a pulsed portion having a predefined frequency, and said receiver is configured to detect said predefined frequency.

30 79. The hospital bed of claim 78, wherein said pulsed portion has a frequency of approximately 57 MHz and a duration of approximately 600 microseconds.

80. The hospital bed of claim 74, wherein said detector comprises a force sensing tape switch including elongated upper and lower contacts.

81. The hospital bed of claim 74, wherein said detector comprises a camera configured to capture images of said second component along said path of travel.

82. The hospital bed of claim 81, wherein said control unit is configured to compare the images captured by said camera to predefined images to determine the presence of an obstacle within said path of travel.

83. A patient support apparatus comprising:

a first component;

a second component configured to move relative to said first component along a path of travel;

an emitter supported by one of the first component and the second component, said emitter being configured to transmit a wireless signal having a pulsed portion of a predetermined frequency and duration; and

a detector configured to detect said wireless signal, said detector being configured to provide an indication if it fails to detect said pulsed portion of said wireless signal.

84. The patient support apparatus of claim 83, further comprising a control unit configured to prevent movement of said second component relative to said first component when said detector fails to detect said pulsed portion of said wireless signal.

85. The patient support apparatus of claim 83, wherein said wireless signal comprises electromagnetic radiation.

86. The patient support apparatus of claim 85, wherein said wireless signal comprises infrared light.

87. The patient support apparatus of claim 83, wherein said pulsed portion of said wireless signal has a frequency of approximately 57 MHz.

88. The patient support apparatus of claim 87, wherein said pulsed portion of said wireless signal has a duration of approximately 600 microseconds.

89. The patient support apparatus of claim 83, wherein said first component is one of a base frame and an elevating frame supported by said base

frame, and said second portion is the other of said base frame and said elevating frame.

90. A patient support apparatus comprising:

a first component;

5 a second component configured to move relative to said first component along a path of travel; and

a force sensing switch supported by one of the first component and the second component, said force sensing switch being configured to provide an indication if it detects the application of a predetermined force thereto.

10 91. The patient support apparatus of claim 90, further comprising a control unit configured to prevent movement of said second component relative to said first component when said force sensing switch detects the application of said predetermined force.

15 92. The patient support apparatus of claim 91, wherein said force sensing switch includes a fault condition, said control unit being configured to prevent movement of said second component relative to said first component when said switch is in said fault condition.

20 93. The patient support apparatus of claim 90, wherein said force sensing switch comprises elongated upper and lower contacts, said predetermined force causing said upper and lower contacts to move into electrical communication with each other.

25 94. The patient support apparatus of claim 90, wherein said first component is one of a base frame and an elevating frame supported by said base frame, and said second portion is the other of said base frame and said elevating frame.